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Wyoming Department of Agriculture

Wyoming Department of Environmental Quality, Water Quality Division

In cooperation with the Wyoming Department of Agriculture (WDA) and the Wyoming Department of Environmental Quality (WDEQ) with assistance from the Lake De Smet Conservation District

Pesticides in Ground Water - Johnson County, Wyoming, 2000-01

In 1991, members of local, State, and Federal governments, as well as industry and interest groups, formed the Ground-water and Pesticide Strategy Committee to prepare the State of Wyoming's generic Management Plan for Pesticides in Ground Water. Part of this management plan is to sample and analyze Wyoming's ground water for pesticides. In 1995, the U.S. Geological Survey, in cooperation with the Ground-water and Pesticide Strategy Committee, began statewide implementation of the sampling component of the State of Wyoming's generic Management Plan for Pesticides in Ground Water. In 2000, baseline monitoring began in Johnson County.

PESTICIDES IN GROUND WATER

Synthetic organic pesticides are used to control weeds, insects, and other organisms in a wide variety of agricultural and nonagricultural settings. The use of pesticides has helped to make the United States the world's largest producer of food (Barbash and Resek, 1996). Pesticide use, however, has also been accompanied by concerns about potential adverse effects on the environment and human health. A potential pathway for the transport of pesticides is through hydrologic systems, which supply water for both humans and natural ecosystems. Water is one of the primary ways pesticides are transported from an application area to other locations in the environment (fig. 1) (Barbash and Resek, 1996).

Pesticide contamination of ground water is a national issue because of the widespread use of pesticides, the expense and difficulty of remediating ground water, and the fact that ground water is used for drinking water by about 50 percent of the Nation's population. Concern about pesticides in ground water is especially acute in rural agricultural areas where over 95 percent of the population relies upon ground water for their drinking water (Solley and others, 1998), although application rates and the variety of pesticides used may be greater in urban areas.

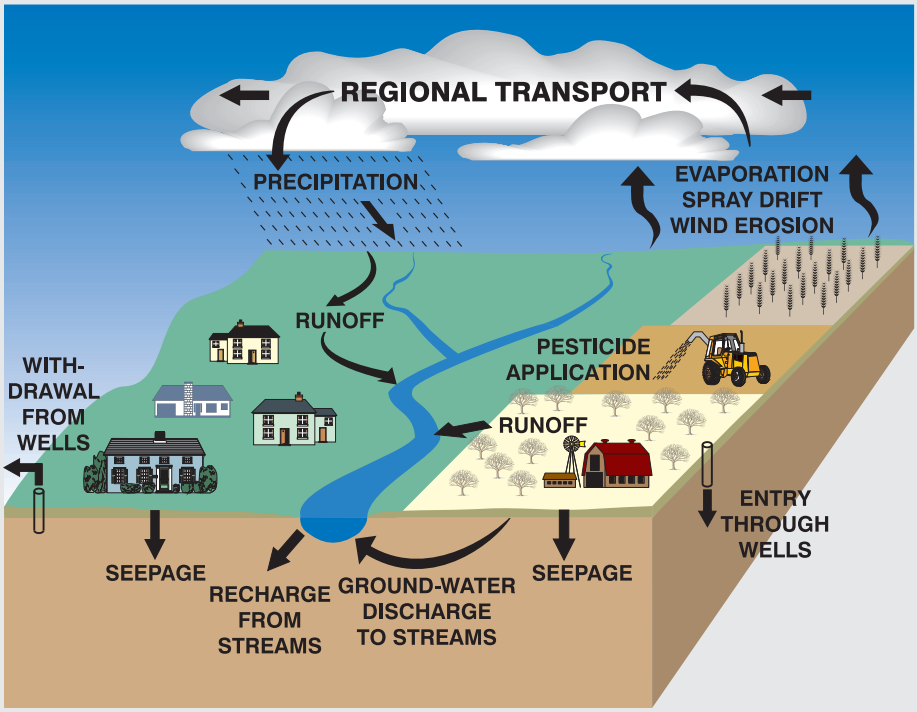

Figure 1. Pathways of pesticide movement in the hydrologic cycle (modified from Barbash and Resek, 1996).

WYOMING'S PESTICIDE MANAGEMENT PLAN

The Ground-water and Pesticide Strategy Committee (GPSC) has developed the generic State Management Plan for Pesticides in Ground Water for the State of Wyoming (SMP) (Wyoming Ground-water and Pesticides Strategy Committee, 1999). The SMP is required by the U.S. Environmental Protection Agency in order for individuals and organizations to continue using certain pesticides in Wyoming. The SMP includes information relating to individuals and organizations involved with the implementation of the SMP, methods of preventing ground-water contamination, ground-water monitoring, and what the responses will be if pesticides are detected in ground water.

One critical part of the SMP is ground-water monitoring. The ground-water monitoring program has two phases. The first phase involves baseline monitoring, which is designed to determine what pesticides, if any, have leached into the county's ground water. The second phase is problem identification monitoring, which is used to gather more information about the ground water near wells with significant pesticide detections.

Table 1. Baseline monitoring for pesticides in Johnson County, late summer 2000 and spring 2001.

[μg/L, micrograms per liter; E, estimated]

Pesticide	Pesticide trade name	Pesticide action[1]	Number of detections/ number of samples[2]	Laboratory minimum reporting limit[3] (μg/L)	Maximum concentration (μg/L)	Average concentration of detections (μg/L)	Safe drinking water standard[4] (μg/L)
Non-focal pesticide detected in Johnson County ground water							
Prometon	Pramitol	Non-selective herbicide	3/20	0.02	E0.006	E0.006	[5]100
Focal pesticides not detected in Johnson County ground water							
Alachlor		Aldicarb Sulfoxide[6]	2,4-D	DCPA	Metolachlor	Simazine	
Aldicarb		Atrazine	Clopyralid	Dicamba	Metribuzin	Tebuthiuron	
Aldicarb Sulfone[6]		Bromacil	Cyanazine	Hexazinone	Picloram	Telone	
Focal pesticides not analyzed in Johnson County ground water (no method of analysis available)							
Difenzoquat		Metsulfuron					

[1]Meister (1996)
[2]Each of the 10 wells was sampled twice.
[3]The laboratory minimum reporting limit is the lowest concentration at which a pesticide concentration can be quantified without estimation.
[4]EPA Maximum Contaminant Level unless otherwise noted (U.S. Environmental Protection Agency, 1996).
[5]EPA Lifetime Health Advisory Level (U.S. Environmental Protection Agency, 1996).
[6]Degradation product of Aldicarb.

Baseline monitoring is prioritized by a county rank and the vulnerability of the county's ground water to pesticides. During the development of the SMP, the GPSC evaluated each county in Wyoming to determine the potential vulnerability of the county's ground water to pesticides. Each county was ranked based on the extent of cropland and urban areas in the county, as well as the amount of pesticides sold within the county in 1991 (Wyoming Ground-water and Pesticides Strategy Committee, 1999).

A ground-water vulnerability map was prepared for the uppermost or shallowest aquifer (Hammerlink and Arneson, 1998). A Geographic Information System was used to overlay seven layers describing hydrogeology and land use. The map was used to assist in the selection of monitoring sites in each county. The monitoring focuses on areas where the ground water is most vulnerable.

The GPSC selected 18 pesticides (focal pesticides) and 2 degradation products to be sampled as part of the SMP (table 1). The chemical analysis used to detect the focal pesticides can also detect 66 other pesticides and degradation products. Any additional pesticides detected are listed in table 1 as non-focal pesticides. Ground water from all wells in the baseline monitoring program was analyzed for the pesticides listed in table 1, with the exception of difenzoquat and metsulfuron, for which analytical methods were not available.

The goal of the ground-water sampling part of the SMP is to collect ground-water samples for pesticide analyses in all 23 Wyoming counties. To date, sampling has been completed in Goshen (1995-96), Park (1997), Washakie (1997-98), Fremont (1998-99), Lincoln (1998-99), Laramie (1998-99), Big Horn (1999-2000), Sheridan (1999-2000), Platte (2000-01), Johnson (2000-01), and Crook (2000-01) Counties. Sampling is currently being conducted in Natrona, Sweetwater, and Teton Counties.

GROUND-WATER MONITORING IN JOHNSON COUNTY

The ground water in Johnson County was ranked tenth most vulnerable to pesticide contamination in Wyoming (Wyoming Ground-water and Pesticide Strategy Committee, 1999). The vulnerability map for Johnson County (fig. 2) (Hammerlink and Arneson, 1998), identifies shallow alluvial and terrace deposits and some of the high mountain areas as the most vulnerable in the county. The high mountain areas were not sampled, as pesticides are rarely used in those areas.

Ten wells were selected in Johnson County (fig. 3) for baseline monitoring. All wells were located in the Quaternary deposits deemed most vulnerable (shown as red or yellow in fig. 2). The wells were selected with the assistance of the Lake DeSmet Conservation District. All wells were sampled twice, in late summer 2000 and spring 2001.

None of the 18 focal pesticides were detected in Johnson County (table 1). The non-focal pesticide detected in Johnson County was found in 3 of the 10 wells sampled; the concentrations detected were less than 1/15,000 of the applicable drinking-water standard (U.S. Environmental Protection Agency, 1996) (table 1). All detections were less than the minimum reporting level, at trace concentrations. A trace concentration indicates that the pesticide was detected, but at a concentration too small to quantify without estimation. Trace concentrations are qualified with an "E" (table 1).

The only pesticide detected in Johnson County was prometon (detected in 3 out of 20 samples), the active ingredient in Pramitol. Prometon is a general-use pesticide and its detection is typically associated with urban land use (Barbash and others, 1999). Prometon was the most commonly detected pesticide in Sheridan County. This is different than most counties sampled for baseline monitoring, where atrazine was the most commonly detected pesticide (Goshen, Park, Washakie, Fremont, Laramie, Big Horn, and Platte Counties).

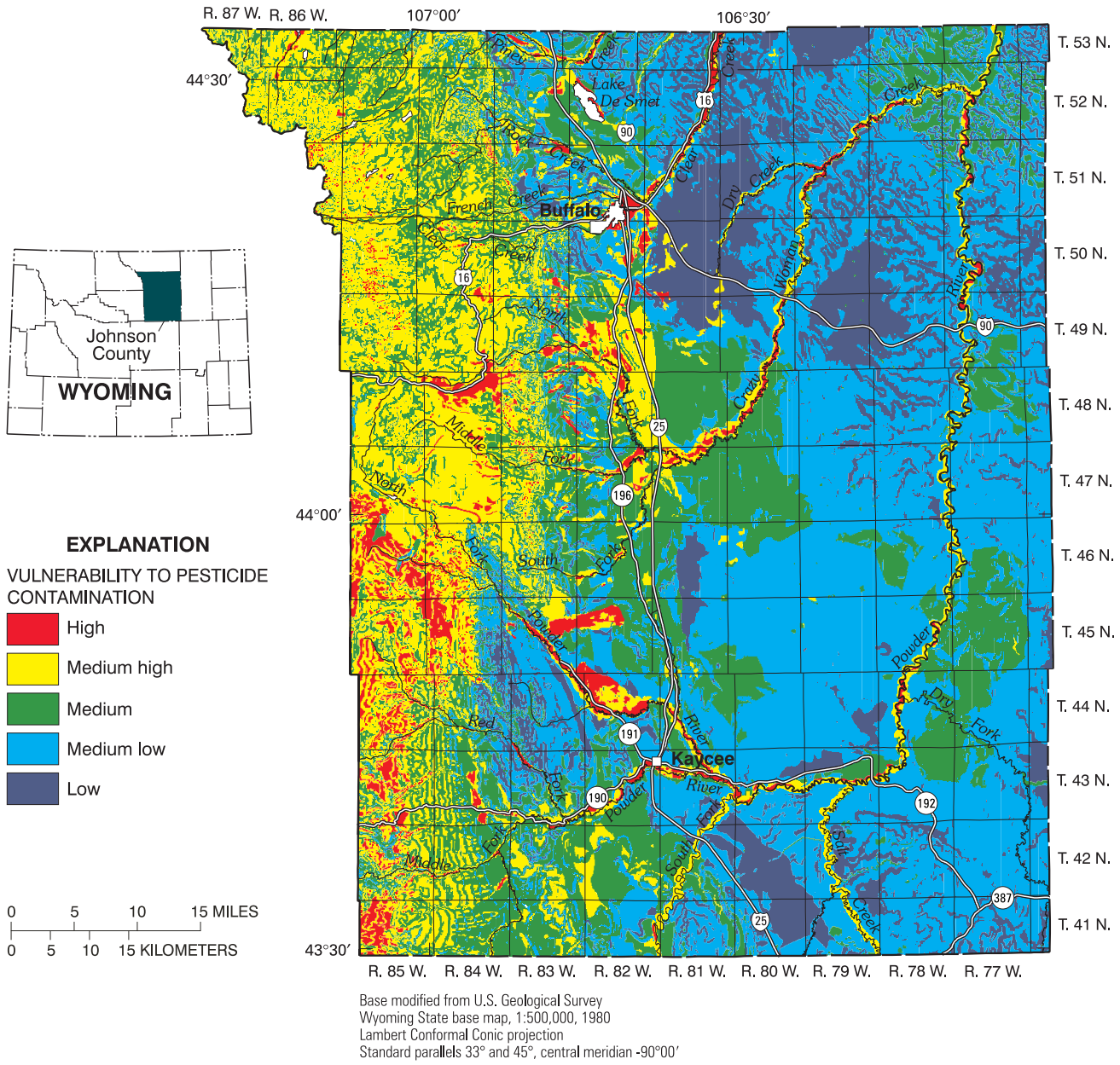

Figure 2. Vulnerability of Johnson County ground water to pesticide contamination (from Hammerlink and Arneson, 1998).

DATA DISTRIBUTION AND AVAILABILITY

The sampling results have been provided to local groups interested in pesticides in ground water in Johnson County. The information can be used by citizens and local governments to help understand current conditions. Analytical results of the Johnson County sampling can be found in Mason and others (2001), and Swanson and others (2002). Analytical results and fact sheets for all counties sampled to date are available from the U.S. Geological Survey in Cheyenne, either by phone, email, or the internet (http://wy.water.usgs.gov/projects/pesticide/).

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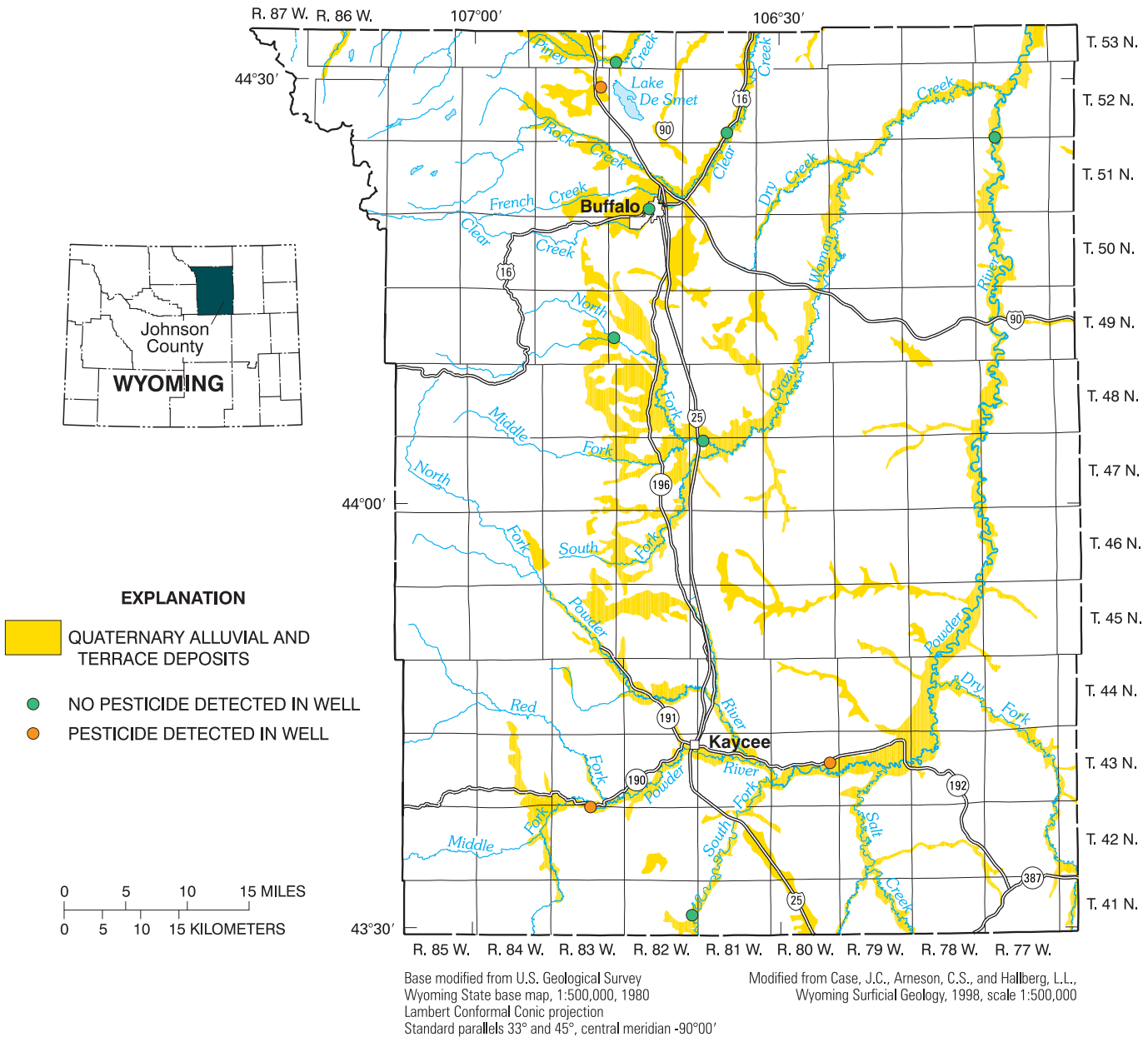

Figure 3. Location of wells sampled in Johnson County, Wyoming, and notation of pesticide detection in each well.

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